

REMARKS

Summary of the Office Action

In the Office Action, Examiner:

- Objected to the drawings under 37 CFR 1.83(a) as not showing every feature in the claims;
- Objected to Claims 1, 22, and 23 for informalities;
- Rejected Claims 12-14 and 19-21 under 35 U.S.C. § 112, first paragraph, as failing to comply with the enablement requirement;
- Rejected Claims 4, 7, 11, 14 and 21 under 35 U.S.C. § 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which Applicant regards as the invention;
- Rejected Claims 1, 2, 4, 8, 9, 11, 15-17, and 22 under 35 U.S.C. § 103(a) as unpatentable over WO 02/060653 ("Harris") in view of United States Patent No. 4,565,104 ("Akin");
- Rejected Claims 3 and 10 under 35 U.S.C. § 103(a) as unpatentable over Harris in view of Akin and in further view of United States Patent No. 4,825,714 ("Yamanaka");
- Rejected Claims 5-7, 12-14, and 23 under 35 U.S.C. § 103(a) as unpatentable over Harris in view of Akin and in further view of United States Publication No. 2003/0109953 ("Zufle");
- Rejected Claim 18 under 35 U.S.C. § 103(a) as unpatentable over Harris in view of Akin and in further view of United States Patent No. 6,494,005 ("Zimmerman"); and
- Rejected Claims 19-21 under 35 U.S.C. § 103(a) as unpatentable over Harris in view of Akin and Zimmerman and in further view of Zufle.

By this Reply, Claims 1, 8, 22, and 23 are amended to correct informalities; Claims 1, 22, and 23 have been further amended to delete non-essential matter; Claims 7, 14, and 21 were amended to provide antecedent bases for certain elements; and Claims 24 and 25 have been

added. Therefore, upon entry of the amendments, Claims 1-25 are pending. No new matter has been added.

Objection to the Drawings and Rejections 35 U.S.C. § 112, First Paragraph

Examiner objected to the drawings as not illustrating the second input encoder, the second output encoder, the third output encoder, and the third input encoder recited in Claims 12-14 and 19-21. Applicant respectfully submits that the drawings are complete as filed, and the disclosure is enabling. Specifically, illustration of encoders is not necessary. The encoder elements are very well known to one of ordinary skill in the art, and their functionality and definition can be well understood from the disclosure taken as a whole. Therefore, it is not necessary to represent the encoders in the drawings.

In this regard, the basis and support for the first output position encoder, which measures the angular position of the arm with respect to a first axis (e.g. the vertical yaw axis) can be found in the embodiment described on page 6 lines 8-11 and shown on Fig. 3 with reference to the encoder 38 and the thin reflective strip 42 and sensor 44.

The first input position encoder, for measuring the rotation of a first motor (e.g. motor 30'), is discussed on page 6 lines 21-27 which refers to an additional safety sensor (which, it is noted, is not shown in the figures) that is built into the motor 30', i.e. in this embodiment the first input positioning encoder corresponds to the safety sensor.

Turning now to the second output positioning encoder, for measuring the angular position of the arm with respect to a second axis (i.e. the horizontal pitch axis), and the second input position encoder, support and basis for which can be found on page 7 lines 5-9. This passage mentions that the mechanism for controlling the rotation of the head above the horizontal pitch axis is virtually identical to the mechanism already described for rotation about the vertical yaw axis and accordingly the mechanisms are not described separately. However, a person of ordinary skill would, from this passage and the passages regarding the first input and output encoders, obtain an enabling disclosure regarding the second input and output encoders.

Turning now to the third output positioning encoder, for measuring the extension position of the arm, this is described in the application on page 7 lines 17-23 and shown in Fig. 9 with regards to the positioning strip 60 and a position sensor which is not visible in the figure.

Finally, the third input positioning encoder for measuring the rotation of the third motor is discussed on page 7 lines 25-26 which states that a sensor, which is not shown in the figures, is provided in association with the motor.

Notwithstanding the above, it is noted that these features are present in the claims of the International Application as filed and published. Accordingly, these features were present and disclosed in the US application as originally filed.

It is respectfully submitted that a person of ordinary skill in the art, when presented with the above-mentioned passages of the application would be provided with a written description of the invention and the manner and processes of making and using it that is sufficiently clear and concise so as to enable the skilled person to make and use the same.

Rejections 35 under U.S.C. § 112, Second Paragraph

Examiner rejected Claims 4, 7, 11, and 21 as being indefinite for including the word “high.” Applicant traverses this rejection.

Examiner objected to the term “high” in Claims 4 and 11 which Examiner deems to be a relative and indefinite term and that the specification does not provide a standard for ascertaining the requisite degree. In this regard, it is noted that on page 6 lines 1-6 the specification discusses a high lead angle such that it allows for low gear ratios to be used as well as allowing the system to be back drivable such that the surgeon can simply pull the arm manually and no gear box would be required. It is respectfully submitted that a person of ordinary skill in the art would, in light of the description of the specification, readily understand the technical meaning and requirements of a screw having a “high lead angle.”

Rejections under 35 U.S.C. § 103(a)

Claims 1-23 were rejected as unpatentable over Harris in view of various references. Applicant traverses these rejections.

Claims 1, 22, and 23 have been amended to reflect the scope of the corresponding European application which has been accepted for grant at the European Patent Office. Specifically, Claims 1, 22 and 23 have been amended to remove the feature “(b) a force sensor for sensing forces applied to the driving member by the user;” and also the phrase “in response to the sensed forces” from previous (d) has been deleted.

Support and basis for the removal of these features can be found on page 1 lines 17-18 which states that "Force feedback mechanisms may also be provided so that the surgeon receives tactile feedback through the handle." Accordingly, it was clearly envisioned that the force feedback mechanisms, e.g. the use of force sensors, are optional. Thus, these non-essential features have been removed from the independent claims and have been made the subject of new dependent claims 24 and 25.

Examiner has acknowledged the novelty of independent Claim 1 over the disclosure of Harris in light of its distinguishing features of "a first rotational motor coupled to a first lead screw and a bearing which moves longitudinal of the first lead screw as it rotates, the bearing being pivotally coupled to an offset crank of or secured to the arm." However, Examiner asserted these distinguishing features are disclosed in Akin and that it would have been obvious to one having ordinary skill in the art to modify Harris so as to provide the distinguishing features from Akin.

Applicant respectfully disagrees with Examiner in this regard.

First, the present invention and Akin are from non-analogous arts. The presently claimed invention relates to a surgical robot whereas the device of Akin is an industrial device for moving large loads, see, e.g., Akin at column 1 lines 14-17. Accordingly, it would not have been obvious to a person of ordinary skill in the art to contemplate the disclosure of Akin from the field of industrial moving/rotating devices let alone combine the disclosure of Akin with the disclosure of Harris since Akin is in a disparate and completely different technical field where vastly different considerations regarding safety, accuracy and maneuverability apply.

Additionally, Harris teaches away from combination with Akin. A person of ordinary skill in the art, when reading Harris would be positively dissuaded from the disclosure of Akin, since on page 8, lines 22-26 of Harris, the difference between industrial robots and special purpose surgical robots are highlighted. It also mentions that the features typical in industrial robots are undesirable in surgical robots as they may introduce safety issues.

Notwithstanding the above, even if a skilled person were somehow to be inclined to modify the robot of Harris to incorporate the linear actuator of Akin, such a combination of features would, in any event, still not fall within the scope of the presently claimed invention. Importantly, the presently claimed invention provides a back drivable robot. As explained on

page 6, lines 1-6 of the present application, back drivability of the robot is enabled, for example via the lead screw being formed with a high lead angle which allows the system to be back drivable as well as enabling low gear ratios or no gear box being required. Accordingly, a user could simply pull the arm around manually. By providing a back drivable surgical robot, the movement of the robot has low impedance. Thus, the user is able to receive direct feedback via the manually graspable driving member such that, for example, the user can obtain direct feedback when performing surgery.

While Harris does disclose a back drivable mechanism 20 in Fig. 4, this mechanism comprises a servo-controlled motor connected to a first gear and a second gear coupled to the first gear. The second gear is connected to a body member and enables yaw movement of the body member (see Harris at page 12 line 26 – page 13, line 3). However, a person of ordinary skill in the art, were he to incorporate the linear actuator of Akin to control the position of the supporting arm, would replace the back drivable mechanism of Harris with the linear actuator of Akin.

Importantly, the linear actuator of Akin is not a back drivable drive mechanism. As evident from Akin's Figs. 1 and 8, due to the narrow pitch of the threaded shaft, the linear actuator would not be back drivable, i.e. one could not move the nut 37 along the threaded shaft 38 so as to rotate the shaft. Indeed, since the linear actuator of Akin is designed for rotating large loads, back drivability would not be a desirable attribute. Since, in the event of power loss, a large load which had been rotated by a back drivable drive mechanism would swiftly rotate back to a ground state.

Furthermore, the inclusion of the linear actuator of Akin with the robot of Harris would not provide a manually graspable driving member. Due to the non-back drivability of the linear actuator of Akin, the grip member of Harris would not be suitable for driving the linear actuator.

There is no reason for a person of ordinary skill in the art to make strides in a particular direction without a hint or other motivation to do so. When considering the teaching of the prior art as a whole, and without using hindsight based on knowledge of the claimed invention, a person of ordinary skill in the art would not have intuitively arrived at the claimed invention. A key consideration to be kept in mind when assessing the obviousness of a claim is not whether a person of ordinary skill could have arrived at the claimed solution with plain and logical steps,

but whether or not he would have arrived at the present invention since the prior art incited him to do so.

The person of ordinary skill in the art would have to exercise inventive effort to move from the device of Harris to the presently claimed invention. It is submitted that it would take knowledge of the invention, i.e. impermissible hindsight, to alight upon Akin from the starting point of Harris and further modify the device so as to provide back drivability in order to arrive at the claimed invention since the prior art provides no teaching, suggestion or motivation for the skilled person to do so.

Accordingly, it is submitted that independent Claim 1 is both novel and inventive in light of the cited prior art.

Since the dependent claims are based upon novel and inventive independent claims, Applicant submits that these claims ought to be correspondingly allowable.

For the same reasons, Applicant submits that Claims 22 and 23 are allowable as well.

Conclusion

As a result of the above Amendments and Remarks, Applicant respectfully submits that the Application is in condition for allowance. If any deficiencies remain, Examiner is invited to telephone the undersigned to facilitate allowance of the claims.

Respectfully submitted,

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